

CLAIMS

What is claimed is:

1. An ultrasonic imaging apparatus for imaging a portion of patient anatomy using an ultrasonic transducer and an ultrasonic detector, the system comprising:
first and second tanks filled with a selected ultrasonically transmissive fluid, the first tank containing the ultrasonic transducer and the second tank containing at least a portion of the ultrasonic detector;
a third tank positioned intermediate the first and second tanks and adapted to receive the portion of the patient anatomy to be imaged, the third tank being filled with the selected ultrasonically transmissive fluid; and
first and second endwalls to define boundaries between the first and third tanks and between the second and third tanks, respectively, the first and second endwalls being made of a material that is ultrasonically transmissive.
2. The system of claim 1 wherein the first and second endwalls are manufactured from cross-linked polystyrene.
3. The system of claim 1 wherein the first and second endwalls are manufactured from TPX.
4. The system of claim 1 wherein the first and second endwalls are manufactured from material having an impedance such that the reflection of ultrasonic signals is no greater than one percent.
5. The system of claim 1 wherein the third tank comprises first and second opposing sidewalls, the system further comprising an access panel in the first sidewall to permit access to the portion of the patient anatomy to be imaged.

6. The system of claim 5, further comprising a drain aperture to drain selected ultrasonically transmissive fluid from the third tank wherein acoustical coupling between the ultrasonic transducer and the ultrasonic detector is maintained via the selected ultrasonically transmissive fluid in the first and second tanks and the portion of the patient anatomy to be imaged.

7. The system of claim 1, further comprising a fluid holding tank coupled to the third tank to hold a reserve volume of the selected ultrasonically transmissive fluid.

8. The system of claim 7, further comprising a temperature control system to control the temperature of the selected ultrasonically transmissive fluid in the fluid holding tank.

9. The system of claim 1 wherein the selected ultrasonically transmissive fluid is water.

10. The system of claim 1 wherein at least one of the first and second endwalls is moveable to retain the portion of the patient anatomy to be imaged.

11. The system of claim 10, further comprising a flexible coupling to couple the moveable endwall to its respective tank.

12. The system of claim 10 wherein movement of the moveable endwall causes a change in a volume of fluid contained in its respective tank, the system further comprising a fluid reservoir in fluid communication with the tank coupled to the moveable endwall to maintain a fluid level of the selected ultrasonically transmissive fluid in the tank.

indicate the predetermined focal plane with respect to an external portion of the patient anatomy.

24. The system of claim 23 wherein the visual indicator comprises a light bar projected onto the external portion of the patient anatomy to indicate the predetermined focal plane with respect to the external portion of the patient anatomy.

25. The system of claim 19, further comprising a tracking system to determine the coordinates of a location of the structure from which a sample will be taken for biopsy.

26. The system of claim 25 wherein the ultrasonic imaging apparatus includes a lens system to focus on a predetermined focal plane wherein the display displays a two-dimensional image of the structure from which a sample will be taken for biopsy and wherein the tracking system determines the coordinates in three-dimensional space using data related the predetermined focal plane in the display image to determine the coordinates in a two-dimensional plane and using data related to the predetermined focal plane to determine the coordinates in a third dimension.

27. The system of claim 25, further comprising a robotic member to automatically position a biopsy device at the coordinates of the location of a structure from which a sample will be taken for biopsy.

28. A method of ultrasonic imaging of a portion of patient anatomy using an ultrasonic transducer and an ultrasonic detector, the method comprising:

activating the ultrasonic transducer in a first tank containing the ultrasonic detector to generate ultrasonic signals, the first tank being filled with a selected ultrasonically transmissive fluid;

coupling ultrasonic signals through an ultrasonically transmissive first endwall between the first tank and a second tank;

receiving the portion of the patient anatomy to be imaged in the second tank filled with the ultrasonically transmissive fluid;

coupling ultrasonic signals through an ultrasonically transmissive second endwall between the second tank and a third tank; and

detecting ultrasonic signals with the ultrasonic detector in the third tank containing the ultrasonic detector, the third tank being filled with the ultrasonically transmissive fluid.

29. The method of claim 28 wherein the first and second endwalls are manufactured from cross-linked polystyrene.

30. The method of claim 28 wherein the first and second endwalls are manufactured from material having an impedance such that the reflection of ultrasonic signals is no greater than one percent.

31. The method of claim 28 wherein the second tank comprises an access panel to permit access to the portion of the patient anatomy to be imaged, the method further comprising accessing the portion of the patient anatomy to be imaged via the access panel.

32. The method of claim 31, further comprising draining the ultrasonically transmissive fluid from the second tank wherein acoustical coupling between the ultrasonic transducer and the ultrasonic detector is maintained via the selected ultrasonically transmissive fluid in the first and third tanks and the portion of the patient anatomy to be imaged.

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33. The system of claim 28 wherein the selected ultrasonically transmissive fluid is water.

34. The method of claim 28 wherein at least one of the first and second endwalls is moveable, the method further comprising moving the at least one of the first and second endwalls to retain the portion of the patient anatomy to be imaged.

35. The method of claim 34 wherein movement of the moveable endwall causes a change in a volume of fluid contained in its respective tank, the method further comprising maintaining a predetermined fluid level of the ultrasonically transmissive fluid in the tank by moving fluid to and from a fluid reservoir in fluid communication with the tank coupled to the moveable endwall.

36. The method of claim 28 wherein the first and second endwalls are moveable, the method further comprising moving the first and second endwalls to retain the portion of the patient anatomy to be imaged.

37. The method of claim 36 wherein movement of the first and second endwalls causes a change in a volume of fluid contained in the first and third tanks, the method further comprising maintaining a predetermined fluid level of the ultrasonically transmissive fluid in the first and third tanks by moving fluid to and from a fluid reservoir in fluid communication with the first and third tanks.

38. The method of claim 28 wherein the ultrasound energy detected by the ultrasound detector provides imaging of a predetermined focal plane in the portion of the patient anatomy to be imaged, the method further comprising providing a visual indicator of the predetermined focal plane to indicate the predetermined focal plane with respect to an external portion of the patient anatomy.

39. A method for guiding a biopsy device using an ultrasonic imaging apparatus for imaging a portion of patient anatomy, the method comprising:

positioning the portion of the patient anatomy to be imaged in a first chamber containing ultrasonically transmissive fluid with the ultrasonic imaging apparatus being positioned in a location other than the first chamber;

displaying the imaged portion of the anatomy to permit imaging of a structure from which a sample will be taken for biopsy; and

opening an aperture in the first chamber to permit the draining of the ultrasonically transmissive fluid and thereby permit access to the structure from which a sample will be taken for biopsy.

40. The method of claim 39 wherein displaying the imaged portion of the anatomy continues during a biopsy procedure wherein the display displays the imaged portion of the anatomy and a biopsy device.

41. The method of claim 39 wherein the ultrasonic imaging apparatus comprises an ultrasonic transducer, the method further comprising positioning the ultrasonic transducer within a second chamber containing ultrasonically transmissive fluid.

42. The method of claim 41 wherein the ultrasonic imaging apparatus comprises an ultrasonic detector, the method further comprising positioning at least a portion of the ultrasonic detector within a third chamber containing ultrasonically transmissive fluid.

43. The method of claim 39 wherein the display provides an image in a predetermined focal plane of the structure from which a sample will be taken for biopsy, the method further comprising generating a visual indicator of the predetermined focal

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plane to indicate the predetermined focal plane with respect to an external portion of the patient anatomy.

44. The method of claim 43 wherein the visual indicator comprises a light bar projected onto the external portion of the patient anatomy to indicate the predetermined focal plane with respect to the external portion of the patient anatomy.

45. The method of claim 39, further comprising determining the coordinates of a location of the structure from which a sample will be taken for biopsy.

46. The method of claim 45 wherein the ultrasonic imaging apparatus includes a lens system to focus on a predetermined focal plane wherein the display displays a two-dimensional image of the structure from which a sample will be taken for biopsy and wherein determining the coordinates of the location of the structure comprises determining the coordinates in three-dimensional space using data related the predetermined focal plane in the display image to determine the coordinates in a two-dimensional plane and using data related to the predetermined focal plane to determine the coordinates in a third dimension.

47. The method of claim 46, further comprising positioning a biopsy device at the coordinates of the location of a structure from which a sample will be taken for biopsy.

48. The method of claim 46, further comprising automatically positioning a biopsy device at the coordinates of the location of a structure from which a sample will be taken for biopsy.